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SUMMARIES OF PRE-CAMBRIAN LITERATURE OF
NORTH AMERICA FOR 1909, 1910, 1911, AND
PART OF 1912

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IV. ONTARIO, NORTHWEST TERRITORIES, AND THE EAST COAST OF
HUDSON BAY

Allen¹ states that the Woman River area in the Sudbury Mining Division of Ontario, west of Rush Lake, shows the following succession:

Basic igneous dikes	} Relative ages not known
Mica porphyry	
Acid igneous rocks—extrusive and intrusive	
Iron formation	
Basal greenstones	

The series has been intensely folded and extensively brecciated. The strike of the iron formation banding is N. 45° E., but is in some places at right angles to this direction where modified by cross-folding. Everywhere the rocks stand practically on edge. The basal greenstones and the iron formation are intruded by a great many basic and acid dikes, the latter showing gradation into an acid volcanic breccia overlying the iron formation.

The various phases of the iron formation are: (1) finely banded cherty carbonates, (2) hematitic, magnetic, pyritic, cherts, (3) black and red jaspilites, (4) a unique amphibole-magnetite rock, in which the petrographic character of the amphibole suggests riebeckite, and (5) iron ore. The cherty iron carbonates are regarded as the source of the other iron-bearing rocks, although the possibility that some of the varieties may be partly original is not denied. The derivation of the secondary varieties is ascribed to the same katectomorphic and anamorphic processes by which Van Hise has explained the origin of similar derivatives in the other iron formations.

¹ R. C. Allen, "Iron Formation of Woman River Area," *Eighteenth Annual Report of the Bureau of Mines*, 1909, Ontario.

The distribution of the iron ores bears no relation to the present structural features of the formation nor to its present erosion surface.

The relation of the iron formation to the associated igneous rocks is expressed by the following statements: The iron formation is sedimentary; it conformably overlies the ellipsoidal greenstones, in that no period of subaerial erosion intervened between the deposition of the iron formation and the greenstone; the iron formation and the overlying volcanic breccia and rhyolite porphyry are also conformable. The evidence of the sedimentary origin of the iron formation consists in its banding, the iron carbonate content, and the parallelism of the individual bands to each other and to the basal plane.

The evidence for conformity with the basal greenstone lies in the parallelism of the banding of the iron formation with the plane of contact with the greenstone, the absence of detrital material, and the probable subaqueous origin of the ellipsoidal greenstones. The conformity of the iron formation and the overlying acid igneous rocks appears probable but is not supported by many field observations, owing to the sparsity of exposed contacts. Wherever observed, the contacts are sharp and show no detrital materials.

From field relations of the iron formation to igneous rocks in the Woman River and other areas but mainly from the work of Van Hise and Leith, Allen believes that the genesis of the iron formations was related to igneous rather than sedimentary agencies and processes. He interprets the physical history of this area to be extrusion of basic greenstones upon a submerged floor, rapidly followed by the precipitation of iron formation, contributed from magmatic solutions, without the intervention of clastic sedimentation. The precipitation of the iron formation was followed by the extrusion of acid igneous rocks. The three rock types, however, basal greenstone, iron formations, and acid igneous rock, are perhaps differentiates of one parent-magma.

Adams[†] describes the occurrence of silver and calcite, in wall rock adjacent to a fissure vein of the Cobalt district.

[†] F. D. Adams, "Notes on the Occurrence of the Ore Body at the City of Cobalt Mine," *Jour. Can. Min. Inst.*, XII (1909), 414-17.

Baker¹ states that the pre-Cambrian rocks of the Lower Mattagami basin are pink gneisses of Laurentian age, Post-Middle Huronian diabase dikes, a small outcrop of a banded siderite, quartz conglomerate, and quartzite which may be Upper Huronian.

Baker² states that the pre-Cambrian in the Lake Abitibi area consists of Keewatin schistose, ellipsoidal greenstones, and other metamorphosed eruptive rocks infolded with dolomites, graphitic slates, jaspilites, and fragmental materials, all intruded by Laurentian granites, pegmatites, and granite porphyries. This old complex is intruded by post-Huronian quartz diabase, quartz gabbro, and Campophyric and aplitic dikes. The diabase is associated with veins showing traces of silver and gold, but no important metal deposits have thus far been found.

Baker³ states that the pre-Cambrian rocks of the Mattagami River region are Laurentian granites and gneisses intruded by diabase dikes, probably Post Middle Huronian in age, Upper Huronian siderite, sideritic conglomerate, and quartzite.

Bancroft⁴ reports the following pre-Cambrian formations from the Keekeek and Kewagama Lakes region, 40 miles northeast of Lake Temiskaming.

Post Huronian—	dikes and stocks of basic intrusives probably Keweenawan
Huronian (?)	—conglomerate, arkose, and graywacke—all schistose
Laurentian	—batholiths and stocks of granite and syenite
Keewatin	—basic and acid schists, iron formation, tuffs, volcanic breccias, rhyolites, basalts, basic and acid extrusives

Burrows⁵ states that the South Lorrain silver area is north of the Montreal River and west of Lake Temiskaming, and about 16 miles southeast of the Cobalt district. The pre-Cambrian rocks are Keewatin, basic igneous rocks, and minor acid intrusives, intruded

¹ M. B. Baker, "Iron and Lignite in the Mattagami Basin," *Ont. Bur. Mines, 20th Ann. Rept.*, pp. 214-46, 37 figs.

² M. B. Baker, "Lake Abitibi Area," *Ont. Bur. of Mines, 18th Ann. Rept.*, XVIII (1909), 263-83, pl. 1, 9 figs.

³ M. B. Baker, "The Iron Ores of the Mattagami River," *Jour. Can. Min. Inst.*, XIV, 299-309.

⁴ J. Austin Bancroft, "Report on the Geology and Mineral Resources of Keekeek and Kewagama Lakes Region," *Province of Quebec*, 1911, pp. 160.

⁵ "South Lorrain Silver Area," *Ont. Bur. Mines, 18th Ann. Rept. (1908) pt. 2*, pp. 21-31, 1909.

by Laurentian granite and syenite; Huronian quartzite, arkose, conglomerate, slate, and breccia, unconformably above the Keewatin and Laurentian; and post-Huronian diabase intrusives. Quartz and calcite veins bearing native silver, smaltite, and niceolite have been found near contacts between the post-Huronian diabase intrusives, and Keewatin basic igneous rocks.

Burrows¹ reports that the pre-Cambrian succession in the Gowganda and Miller Lake silver area between Sudbury and Cobalt is Keewatin altered basic igneous rocks and acid porphyries, intruded by Laurentian granite, syenite, and gneiss; unconformity; Huronian quartzite, arkose, graywacke, conglomerate, and slate; intrusive into all the preceding, post-Middle-Huronian diabase. The diabase contains silver-bearing veins whose value has not been determined.

Burrows² finds that the compact rocks of the Porcupine district 100 miles northwest of the Cobalt district, are all pre-Cambrian, principally Keewatin. Keewatin and Huronian rocks contain irregular gold-bearing veins, in which quartz is the dominant mineral.

Bowen³ reports that sills and dikes of diabase cut older formations in the Gowganda Lake district. The dikes, some of them 250 feet wide, show no evidence of differentiation. Red spots composed of an intergrowth of quartz and soda-rich plagioclase feldspar occur in the diabase of the sills. At the contact of sills and slate, a granophyre consisting of soda-rich plagioclase, quartz, and accessory minerals including calcite grades into a slate adinole developed by contact metamorphism. The granophyre and adinole are both ascribed to hydrothermal actions, the granophyre being regarded as an extreme phase of the alteration of the slate, a recrystallization from a state of aqueous fusion.

To the reviewer, it seems that the red spots in the sills, and the granophyre, may be due to the same causes, since they are

¹ A. G. Burrows, "The Gowganda and Miller Lakes Silver Area," *Ont. Bur. Mines, 18th Ann. Rept.*, XVIII (1908), Pt. 2, pp. 1-20, 20 figs., 3 maps.

² A. G. Burrows, "Porcupine Gold Area," *Quart. Bull. Canadian Min. Inst.*, No. 16, 1911, pp. 59-62.

³ Norman L. Bowen, "Diabase and Granophyre of the Gowganda Lake District, Ontario," *Jour. Geol.*, XVIII, No. 7 (1910), 658-74.

mineralogically similar and are gradational. Bowen believes that the granophyre may be quite different in origin from the red spots scattered through the sills, despite their similarity. A somewhat similar phenomenon in the Cobalt district, the separation of diabase and aplite, has been ascribed to differentiation by Collins and Hore, Collins showing that the separation depended on the rate of cooling, being entirely absent in diabase, which was rapidly chilled. A magmatic separation of soda-rich aplite and gabbro in the intrusive of Mt. Bohemia, Mich., has been described by F. E. Wright. Here there is no evidence that the aplite was associated with slate.

Bowen¹ presents chemical analyses and descriptions of the diabase and aplite of the Cobalt silver area.

Bowen² describes the rocks of the Thunder Bay district as Upper Huronian argillites, gray quartzite and gray slates interstratified, black slate, and iron formation, all unconformable above the Laurentian granite complex, and intruded by Keweenawan diabase dikes and sills. Silver veins are found in steeply dipping fault zones cutting the black slate in an east-west direction. The ore minerals are principally native silver and argentite, associated with calcite, quartz, fluorite, barite, witherite, and other minerals.

Coleman³ states that the rocks of the Black Sturgeon Lake district southwest of Lake Nipigon are Keewatin green schists intruded by granite gneiss, and slightly disturbed Keweenawan diabase, shale, and sandstone. Hematite veins are found in fault zones of the Keewatin.

Coleman⁴ reports that the Alexo nickel deposit near Matheson, northern Ontario, consists of a pyrrhotiferous nickel-bearing rock of unknown extent, grading upward into an ultra basic rock, peridotite altered to serpentine, and resting on footwall of andesite.

¹ N. L. Bowen, "Diabase and Aplite of the Cobalt-Silver Area," *Jour. Can. Min. Inst.*, XII (1909), 517-28.

² N. L. Bowen, "Silver in Thunder Bay District," *Ont. Bur. Mines, 20th Ann. Rept.*, pp. 119-32.

³ A. P. Coleman, "The Black Sturgeon Lake District," *Ont. Bur. Mines, 18th Ann. Rept.*, Pt. 1, pp. 163-179.

⁴ A. P. Coleman, "The Alexo Nickel Deposits," *Econ. Geol.*, V, No. 4 (1910), Pt. 4, 372-76.

Coleman interprets the deposit as a marginal magmatic segregation from the peridotite.

Collins¹ finds that the pre-Cambrian rocks in the region between Lake Nipigon west of Clay Lake, a distance of about 220 miles, include Keewatin and Huronian altered acid and basic intrusives, volcanic tuffs, chlorite, and sericite schist with bands of conglomerate, graywacke, phyllite, quartzite, and jaspilite; Laurentian granites, syenites, and diorites intrusive into the Keewatin; post-Keewatin eruptives, gabbro, mica syenite, acid porphyries, and granite; flat-lying Keweenawan impure dolomite and sandstone, and post-Keweenawan diabase intrusive sheets.

Collins² reports that the pre-Cambrian rocks between the Pic and Nipigon rivers of the north shore of Lake Superior include Laurentian granite, gneisses, and syenite; Keewatin graphitic gneiss, quartzite, arkose, amygdaloids, and basic and acid schists; Keweenawan red arenaceous dolomite, and diabase intrusives; eruptives of unknown age, viz., syenites, diorite, pegmatite, and diabase.

Collins³ states that the cobalt silver ores of northern Ontario are associated with diabases. The diabasic magma has acted as a mixture of two rock species, diabase and aplite, whose segregation was controlled by the rate of cooling, no separation having taken place in rapidly cooled rocks. The aplites show differentiation into quartz veins, and still later quartz calcite veins. The diabase contains some chalcopryrite, the aplite still more, while an even higher percentage is contained in the quartz calcite veins. Neither silver nor cobalt were found in the diabases.

Harvie⁴ states that the succession of Keewatin, Laurentian, and Huronian rocks of the Oposatica district, about 40 miles east of

¹ W. H. Collins, "A Geological Reconnaissance of the Region Traversed by the National Transcontinental Railway between Lake Nipigon and Clay Lake, Ont.," *Canada Geol. Surv. Branch*, 1909, 67 pp., 2 pls., 1 fig., 2 maps.

² W. H. Collins, "Report on the Region Lying North of Lake Superior between Pic and Nipigon Rivers, Ont.," *Canada Geol. Survey*, 1909, 24 pp., 1 map.

³ W. H. Collins, "Quartz Diabases of Nipissing District," *Econ. Geol.*, V, No. 6 (1910), 538-50.

⁴ Robert Harvie, "The Telluride Ores at Oposatica," *Jour. Can. Mining Inst.*, 1911, pp. 164-70.

north from the north end of Lake Temiskaming, is similar to that of the Cobalt district. Narrow gold-bearing quartz ankerite veins are found cutting Keewatin and Huronian rocks in the Oposatica district. The gold minerals are petzite and native gold. The petzite occurs in cracks in the quartz and ankerite, and the native gold was deposited after the petzite. Harvie believes that the Oposatica ores will show no increase in values with depth, since the Tellurides in known districts have all been found below the weathered zone.

Hore¹ discusses the stratigraphy and the ores of the Cobalt district. The richest ores have been found in the Huronian conglomerate. Rich shoots have also been mined in the Keewatin greenstone, and in the Keweenawan diabase. The ores are genetically connected with the diabase intrusions.

Hore² argues that the cobalt silver ores, and the aplites and diabbases with which they are associated are all differentiation products of one magma.

Hore³ believes that the glacial and glacio-fluvial origin of a portion of the conglomerate-quartzite-shale series of Huronian age at Cobalt and Temagami is clear. The evidence consists in the small amount of stratification, the presence of striated and soled pebbles, the heterogeneity of the conglomerate, and the discordance between the lithologic character of the conglomerate and the basement on which it was deposited. The basal conglomerate may not be of glacial origin since they are like the materials on which they lie. Some of the materials are probably water deposits, into which large erratics were introduced by floating ice. Certain thick boulder-free deposits of shale and graywacke are probably ordinary water-laid sediments.

Hore⁴ states that Keewatin and Huronian rocks similar to those of the Nipissing area outcrop in the Porcupine district. The

¹ R. E. Hore, "Geology of the Cobalt District," *Trans. Am. Inst. Min. Eng.*, XLII (1912), 481-98.

² Reginald E. Hore, "Differentiation Products in Quartz Diabase Masses of the Silver Fields of Nipissing, Ontario," *Econ. Geol.*, VI (1911), 51-59.

³ Reginald E. Hore, "Glacial Origin of Huronian Rocks," *Jour. Geol.*, XVIII, No. 5 (1910), pp. 459-67.

⁴ Reginald E. Hore, "On the Nature of Some Porcupine Gold Quartz Deposits," *Jour. Can. Min. Inst.*, XVI, No. 15, pp. 57-70.

Keewatin rocks include acid and basic extrusives, some plutonics jaspilitic iron formation, ferro-dolomites, and schists of unknown origin. The Huronian rocks are chiefly quartzite, graywacke, micaceous schists, and one conglomerate, apparently made up of igneous materials.

Most of the gold ores occur in quartz-bearing veins within metamorphosed igneous rocks of the Keewatin or the Huronian conglomerate. The quartz is full of liquid inclusions and in places is shattered. Gold occurs between quartz veins, included in quartz, in pyrite, and in calcite.

Hore believes that the ores and quartz pyrite gangue were deposited by hot alkaline solutions. He finds that they resemble the ores of the mother-lode closely and that the same hypothesis of origin is applicable to both.

The pre-Cambrian succession in the Nipissing district according to Hore¹ is:

I. Algonkian.

a) Keweenawan. Igneous intrusions of quartz diabase, quartz gabbro with acid differentiation products. Some olivine diabase and diabase porphyrite dikes. Igneous contact.

b) Huronian.

(1) An upper series, probably Middle Huronian. Chiefly feldspathic quartzite with some conglomerate. Barlow's Lorain series. Slight unconformity.

(2) A lower series, probably Lower Huronian, graywacke, shale, conglomerate, and feldspathic quartzite. Miller's Cobalt series. Great unconformity.

II. Archaean.

a) Laurentian. Granites, diorites, syenites, gneisses intrusive into Keewatin.

b) Keewatin. Basic and acid extrusives and intrusives, felsite agglomerate, iron formation, slates and green schist.

The silver ores occur principally in narrow vertical or nearly vertical fissure veins cutting Keweenawan diabase, the lower Huronian series, and the Keewatin. The veins strike in various directions, but are uniform in composition, consisting mainly of smaltite, calcite, and silver, deposited in the order in which they

¹ "The Silver Fields of Nipissing, Ontario," *Can. Min. Inst. Quart. Bull.*, No. 17 (1911), pp. 81-105, 3 pls.

are named. The richest veins are in the Huronian. Hore supports the views that the silver-bearing solutions came from the Keweenawan diabase, that the Keewatin greenstone played an important rôle in their deposition, and that the coarse Huronian sediments afforded abundant openings for their reception.

Hore¹ states that the diabase of the Cobalt district occurs in dikes and sills intrusive into Keewatin schists, and Huronian sediments. The minerals of the diabase are pyroxenes, plagioclase, quartz ilmenite, biotite, and olivine. Olivine seems to be confined to small masses of diabase showing no differentiation. Aplitic micropegmatitic intergrowths of sodic feldspar and quartz, sometimes with calcite, occur in the thick sills. Some of the micropegmatite is clearly a differentiate of the diabase *in situ*, occurring in spots and stringers grading into the diabase. Some of it is a later differentiate, filling fissures sometimes with selvage borders.

A minor fissure filling in the diabase consists of quartz, with chlorite and amphibole. Galena, pyrite, and chalcopyrite are frequently present. Calcite sometimes fills interstices between well-formed crystals of calcite.

King² describes a lens-shaped deposit of low phosphorus, non-titaniferous magnetite ore, which occurs at the contact between Grenville limestone and Laurentian granite at the Wilbur mine, in Lanark County of eastern Ontario.

Knight³ presents diagrams showing faults in the Cobalt district. The largest known fault has a displacement of over two hundred feet. It is of the reversed type and strikes parallel to the longer axis of Cobalt Lake.

Kerr⁴ presents a petrographic description of the Port Caldwell syenite area on the north shore of Lake Superior about 125 miles east of Port Arthur. The principal rock of the region is nepheline

¹ Reginald E. Hore, "Diabase of the Cobalt District, Ontario," *Jour. Geol.*, XVIII, No. 3 (1910), 270f.

² Shirley King, "The Wilbur Iron Mine," *Jour. Can. Min. Inst.*, XII (1909), 582-91.

³ C. W. Knight, "Recent Underground Development Work at Cobalt," *Jour. Can. Min. Inst.*, XV, No. 18 (1912), pp. 21-23, 1 pl.

⁴ H. L. Kerr, "Nepheline Syenites of Port Caldwell," *Ont. Bur. Mines, 10th Ann. Rept.*, Pt. 1, pp. 194-232, 20 figs., 1 map.

syenite with small amounts of hornblende, augite, and magnetite. Several other syenite facies are represented, besides pegmatites, small bodies of gabbro, granite, diorite, and later basic dikes.

Lane¹ presents a detailed description of the records of 17 drill holes, placed along a line normal to the strike of the Keweenaw copper-bearing rocks on Point Mamainse on the east shore of Lake Superior. The copper-bearing series in this cross-section consist of roughly parallel beds of conglomerate, aplite, and porphyrite intruded by felsite. Their strike is about N. 10° W. and their dip is from 20°–50° west or lakeward. The beds are frequently offset by dip faults.

Leith² states that the Algonkian, Nastapoka, and Richmond groups, exposed on the east coast of Hudson Bay, consist of slightly metamorphosed chemical and mechanical sediments, interbedded with basic eruptives, with a seaward dip from 50° to 45°. The Richmond group, unconformably, below the Nastapoka, embraces coarse, ill-assorted mechanical sediments interbedded with basic eruptives, generally dipping seaward at steeper angles than the Nastapoka. The Nastapoka contains an iron formation containing greenalite, iron carbonate, and derivative phases closely related to extrusives. The Nastapoka is probably late Algonkian, perhaps Animikie, because of its structural, stratigraphic, and metamorphic similarity to the Animikie of the Lake Superior region. Leith suggests that during the Algonkian, the Archaean protaxis may have separated the Lake Superior geo-syncline of deposition on the south from a similar region of deposition on the north.

Mickle³ finds that one hundred square miles of the Nipissing region have numerous calcite veins, but that the metal-bearing veins are restricted to ten square miles. On these ten square miles there are about 2,000 calcite veins of which about 1 per cent are metal-bearing, and only 66 veins were productive at the end of 1907. About 24 per cent of the area is underlaid by Huronian

¹ A. C. Lane, "Diamond Drilling at Point Mamainse, Province of Ontario," *Canada Dept. of Mines, Bull. No. 6*, 1911, 59 pp., 1 fig., 1 map, 5 pls.

² C. K. Leith, "An Algonkian Basin in Hudson Bay," *Econ. Geol.*, V, No. 3, pp. 227–46.

³ G. R. Mickle, "The Probable Number of Productive Veins in the Cobalt District," *Jour. Can. Min. Inst.*, XIII (1910), 325–35.

rocks, 42 per cent diabase, and 33 per cent by the Keewatin. The Huronian had 53 productive veins, the Keewatin 6, and the diabase 7. Assuming that these areas have prospected equally well, the chances of finding ore are about 9 times better on the Huronian than on an equal area of Keewatin, and about one-twelfth as good on the diabase as on an equal area of Huronian.

Miller¹ reports that the pre-Cambrian rocks exposed in the district of Patricia, comprising over 146,400 square miles west of James Bay, which has recently been added to the Province of Ontario, include limestones similar to those of the Hastings and Grenville districts, a small volume of Lower-Middle Huronian conglomerates, iron-bearing Animikie, and diabase intrusives, probably Keweenawan.

Miller and Knight² state that they have found an unconformity between the Grenville and the Hastings series of eastern Ontario, the Hastings being younger. The Grenville, they maintain, has been deposited on rocks similar to the Keewatin greenstones of Lake Superior, and the Grenville, therefore, may be the time equivalent of the Keewatin iron formations farther west. The Hastings series they regard as Huronian.

Moore³ describes the geology of the Sturgeon Lake goldfield in 1911. It is located in latitude 50° north longitude, northwest of Thunder Bay. The rocks are pre-Cambrian, largely igneous, including granites, gneisses, aplites, quartz-porphyrries, rhyolites, hornblende-syenite, diorites, diabase, basalts, gabbros, and porphyrites and their metamorphic equivalents. There are small patches of arkose, graywacke, and dolomite. The relations of the igneous rocks to each other is partially known, but the age of the sediments and the igneous rocks and their relations are still uncertain. Free-milling gold veins are found at contacts, and in cleavage and fault planes and other openings. The gangue is principally

¹ W. G. Miller, "District of Patricia," *Ont. Bur. Mines*, XXI, Pt. 2, pp. 200, 18 figs., 29 maps.

² W. G. Miller and C. W. Knight, "Grenville-Hastings Unconformity," Abstract, *Geol. Soc. Am. Bull.*, XIX (1909), 539-40.

³ E. S. Moore, "The Sturgeon Lake Gold Field," *Ont. Bur. Mines*, 20th Ann. Rept., pp. 133-57, 17 figs.

quartz, with small amounts of calcite and siderite. Sulphides of copper, lead, zinc, and iron are also present.

Moore¹ states that the rocks at Round Lake north of Lake Nipigon are Keewatin ellipsoidal greenstone, green schist, fine-grained quartose gneiss, and lean, magnetic, cherty iron formation, intruded by Laurentian granite and gneiss. The Archaean complex is intruded by Keweenawan diabase. The iron formation is separated from the greenstones by schists and sediments. It consists of bands of crystallized chert, magnetite, hematite, and some siderite.

Moore² states that the pre-Cambrian rocks of the Lake Savant Area northwest of Lake Nipigon belong to the Keewatin, Laurentian, Huronian, and possibly Keweenawan systems. The Keewatin comprises acid, intermediate, and basic extrusives and intrusives, banded magnetic, cherty iron formation, and an unusual development of sediments in the form of graywacke and gray gneiss. The Laurentian consists of granites and gneisses intrusive into the Keewatin. The rocks of the Huronian are principally conglomerates, graywacke, and a little quartzite. A few basic dikes may be of Keweenawan age.

Moore³ describes the pyrite deposits of Big Vermilion Lake near the Minnesota boundary. The pre-Cambrian rocks of this region include a basement of intrusive and extrusive acid and basic rocks, overlaid by cherty iron formation, graphitic slate, graywacke, arkose and quartzite. The two systems were intruded by granite. The pyrite occurs in fissure veins in greenstone, quartz porphyry, and iron formation.

Moore⁴ states that the Onaman Iron Range district covers about 70 square miles and lies between 45 and 50 miles up the Red Paint River, northeast of Lake Nipigon. The Keewatin, Laurentian,

¹ E. S. Moore, "Iron Range North of Round Lake," *Ont. Bur. of Mines, 18th Ann. Rept.*, XVIII, Pt. 1, pp. 154-62.

² E. S. Moore, "Lake Savant Iron Range," *Ont. Bur. Mines, 19th Ann. Rept.*, XIX (1910), Pt. 1, pp. 173-93, 16 figs.

³ E. S. Moore, "Vermilion Lake Pyrite Deposits," *Ont. Bur. Mines, 20th Ann. Rept.*, 1911, pp. 199-208, figs. 6, 1 map.

⁴ E. S. Moore, "Geology of Onaman Iron Ranges Area," *Ont. Bur. of Mines, Ann. Rept.*, XVIII (1909), Pt. 1, pp. 196-253, 22 figs., 3 pls., 1 map.

Huronian, Keweenawan, Pleistocene, and Recent rock systems are represented. The Keewatin consists of greenstone and greenstone schists, rhyolite, rhyolite porphyry, and feldspar porphyry, rhyolite tuff, agglomerate, and conglomerate, and iron formation. The Laurentian consists of granite and granite-gneiss, batholiths, intrusives into the Keewatin. The Keweenawan and Huronian are represented by intrusives. Pleistocene drift and Recent alluvial and travertine deposits cover a considerable portion of the district.

The Keewatin iron formation occurs in two nearly parallel, synclinal belts running nearly east and west. Folding was accomplished by fracture and flow, predominantly the latter, although locally the formation is intensely broken and even faulted.

The various iron formation phases consist of cherty iron carbonate, ferruginous cherts, actinolite magnetite quartz rocks, interbedded with clastics whose grain suggests that they are of pyroclastic origin. The cherty iron carbonate and some of the iron oxide phases are probably original. The alterations of the iron formation have been chiefly anamorphic. Among the secondary minerals is dumortierite, a unique basic aluminium silicate, never before reported from iron formation.

Moore finds difficulty in accounting for the clean-cut banding of the iron formation as well as its sharp contact with the interbedded clastics on the hypothesis that the iron salts were contributed by the weathering of basic igneous rocks. These characters he finds in perfect accord with Leith's theory of direct igneous contribution. However, direct evidence for the latter he believes is lacking, since the iron formation is nowhere in direct contact with basic igneous rocks excepting at faults, and is also separated from rhyolite by slates, and what appear to be water-deposited pyroclastics, containing no iron formation. If the clastics in association with the iron formation are pyroclastic in origin, considerable difficulty in the way of the direct-contribution hypothesis would be removed. The iron and silica could have been delivered as well by weathering as by direct contribution in Moore's opinion. He cites the solubility of the silica in the iron formation as shown by Van Hise and Leith, the silica content of bog ores described by Hunt and himself as evidence of the adequacy of weathering in causing the deposition of silica.

While the evidence for the solubility of silica under weathering may be satisfactory, there is very little to show that weathering may yield siliceous deposits of anything like the thickness, high silica content, and freedom from detrital silica and clay as the Lake Superior sedimentary iron formations.

Moore believes that the Keewatin was a period of inclosed basins and imperfect drainage, conditions especially favorable to the solution, transportation, and deposition of iron. The long period of freedom from intense vulcanism, which he believes is implied by the thickness of the iron formation, removes the most apparent difficulty in assuming the development of a luxuriant flora, a condition conducive to the solution of iron and silica, and a selective retention of the complementary clastics on the land areas. Unless it can be shown that the clastics associated with the iron formation are pyroclastic in origin, it is obvious that a great deal of rock was disintegrated by weathering during the Keewatin. With due regard for the facts which may be interpreted as evidence for weathering and magmatic contribution, Moore concludes that the materials of the iron formation were supplied to inclosed basins by weathering action under the influence of plant life, and by heated igneous rocks coming in contact with the waters.

McInnes¹ reports that the pre-Cambrian rocks of the region between N. lat. $50^{\circ} 10'$ and N. lat. $55^{\circ} 10'$, and between W. long. 86° and W. long. 90° , include Keewatin diorites, diabases, and chloritic and hornblende schists, and coarse conglomerates, the latter probably Huronian, and Laurentian biotite granite gneisses.

Parsons² writes detailed descriptions of the gold prospects and mines of the Lake of the Woods, Manitou, and Dryden areas of northwestern Ontario.

Seelye³ states that the Helen limonite ore body at Michipicoten is bounded by cherty iron carbonate, chert, and a diabase dike.

¹ W. McInnes, "Report on a Part of the Northwestern Territories Drained by the Umisk and Ottawapiskat Rivers," *Canada Geol. Survey*, 1910, 54 pp., 5 pls., 1 map.

² A. L. Parsons, "Gold Fields of Lake of the Woods, Manitou and Dryden," *Ont. Bur. Mines*, (1911) pp. 158-98, 26 figs., 4 pls.

³ R. W. Seelye, "The Helen Mine, Michipicoten, Ontario," *Jour. Can. Min. Inst.*, XIII (1910), 121-34.

The ore body contains pockets of pyritic sand which have become more numerous with depth.

Wilson¹ reports on a reconnaissance survey of the area to the north of Lac Seul and east of Trout Lake in the Northwest Territories of Canada. He found only pre-Cambrian rocks, of which the oldest are chiefly hornblende schists and amphibolites. The greater portion of the area is underlaid by granites and gneisses intrusive into the basic rocks.

Wilson² finds that the pre-Cambrian rocks of the Algoma and Thunder Bay districts between 48° 30' and 51° north latitude, and 84° and 87° 30' west longitude, include Laurentian granite and gneiss with some hornblende schists, biotite schist, and diabase which may be Keewatin.

Wilson³ states that the pre-Cambrian succession in the Nipigon river basin is as follows:

Keweenawan

- Diabase intrusives
- Dolomitic limestone
- Shale
- Sandstone
- Unconformity

Lower Huronian

- Small bands of conglomeratic arkose and slate
- Unconformity

Laurentian

- Granites and gneisses intrusive into Keewatin

Keewatin

- Greenstone and greenstone schists infolded with jaspilitic iron formation

Wilson⁴ reports the following pre-Cambrian succession from the region about Larder Lake, Ontario and eastward:

Post Huronian

- Diabase, gabbro, porphyry, and lamprophyre
- Igneous contact

¹ A. W. G. Wilson, "Lac Seul to Cat Lake," *Canada Geol. Survey*, 1909, 23 pp.

² M. E. Wilson, "Geological Reconnaissance of a Portion of Algoma and Thunder Bay Districts, Ontario," *Canada Geol. Surv.*, 1909, 49 pls., 6 pls.

³ A. W. G. Wilson, "Geology of the Nipigon Basin, Ont.," *Canada Geol. Surv. Mem. No. 1*, 1910, 152 pp., 16 pls., 4 figs., 1 map.

⁴ M. E. Wilson, "Larder Lake and Eastward," *Canada Geol. Surv., Summary Rept.*, 1909, pp. 173-79, 1910.

Huronian

Conglomerate

Arkose

Graywacke

Conglomerate

Unconformity

Laurentian

Granite, gneiss, pegmatite, aplite

Igneous contact

Keewatin

Quartz-porphyry and porphyrite

Rusty weathering carbonate rock

Phyllite, slate, and graywacke

Greenstone and green schist